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(54) **NETWORKED LIGHT BULB WITH COLOR WHEEL FOR CONFIGURATION**

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A63B 71/00 (2006.01)

(52) **U.S. Cl.**
USPC ..... **273/143 A**; 273/142 R; 273/138.1; 273/139; 273/280

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See application file for complete search history.

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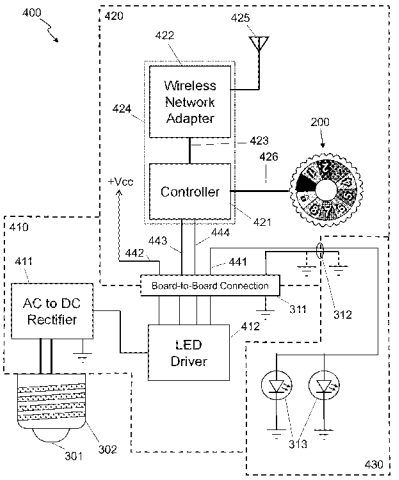
(57) **ABSTRACT**

A networked light bulb is disclosed comprising means for controlling a state of the networked light bulb, means for connecting to a network, means for allowing a user to select a color from a plurality of colors, the plurality of colors having at least one locking color and one or more non-locking colors, and means for generating a selected color code corresponding to the color selected by the user, each color of the plurality of colors having a corresponding color code. If the user selects the locking color, the networked light bulb disconnects from the network and turns the light bulb on. If the user selects a non-locking color, the networked light bulb submits the selected color code over the network for use by the network controller in configuring the device and changes the state of the networked light bulb in response to a command from the network. In some embodiments the networked light bulb also responds to requests for status information from the network independent of the color selected by the user. In some embodiments that means for controlling the networked light bulb controls the brightness of the light.

17 Claims, 7 Drawing Sheets



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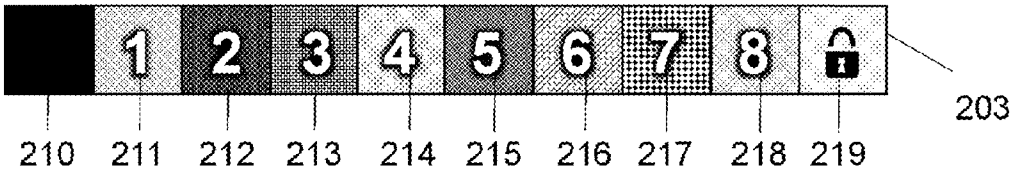
101	102	103	104				105			106
Num	Sym	Color	Print Colors				Computer Colors			Fill
			C%	M%	Y%	K%	R	G	B	
0		Black	50	50	50	100	0	0	0	
1	1	Green	80	0	100	0	0	189	31	
2	2	Blue	100	50	0	0	0	79	217	
3	3	Red	0	100	100	0	227	0	0	
4	4	Yellow	0	0	100	0	255	229	0	
5	5	Violet	50	60	0	0	132	95	207	
6	6	Orange	0	50	100	0	250	138	0	
7	7	Aqua	60	0	10	0	75	195	222	
8	8	Pink	0	55	0	0	255	89	183	
9		White	0	0	0	0	255	255	255	

FIG. 1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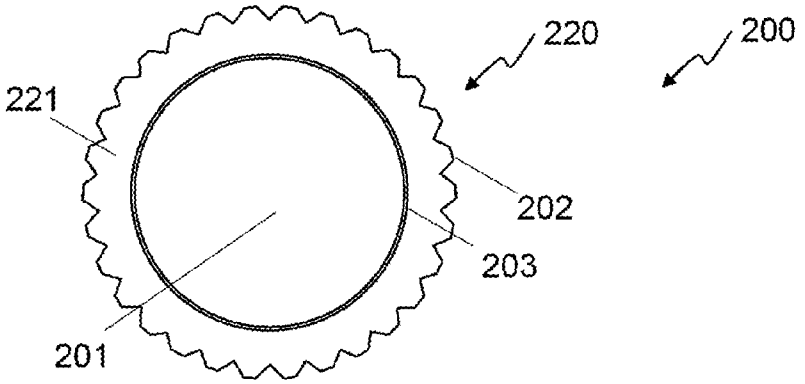
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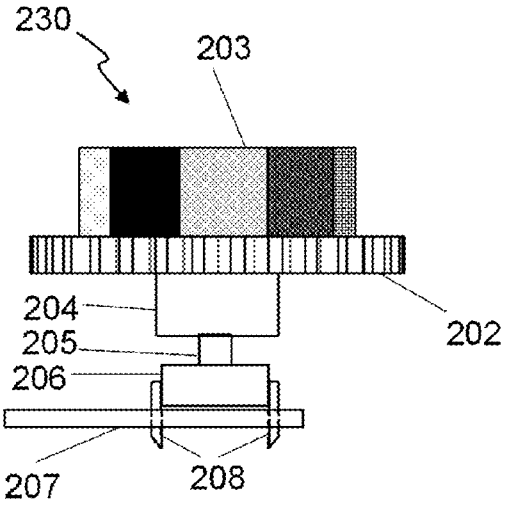
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FIG. 2

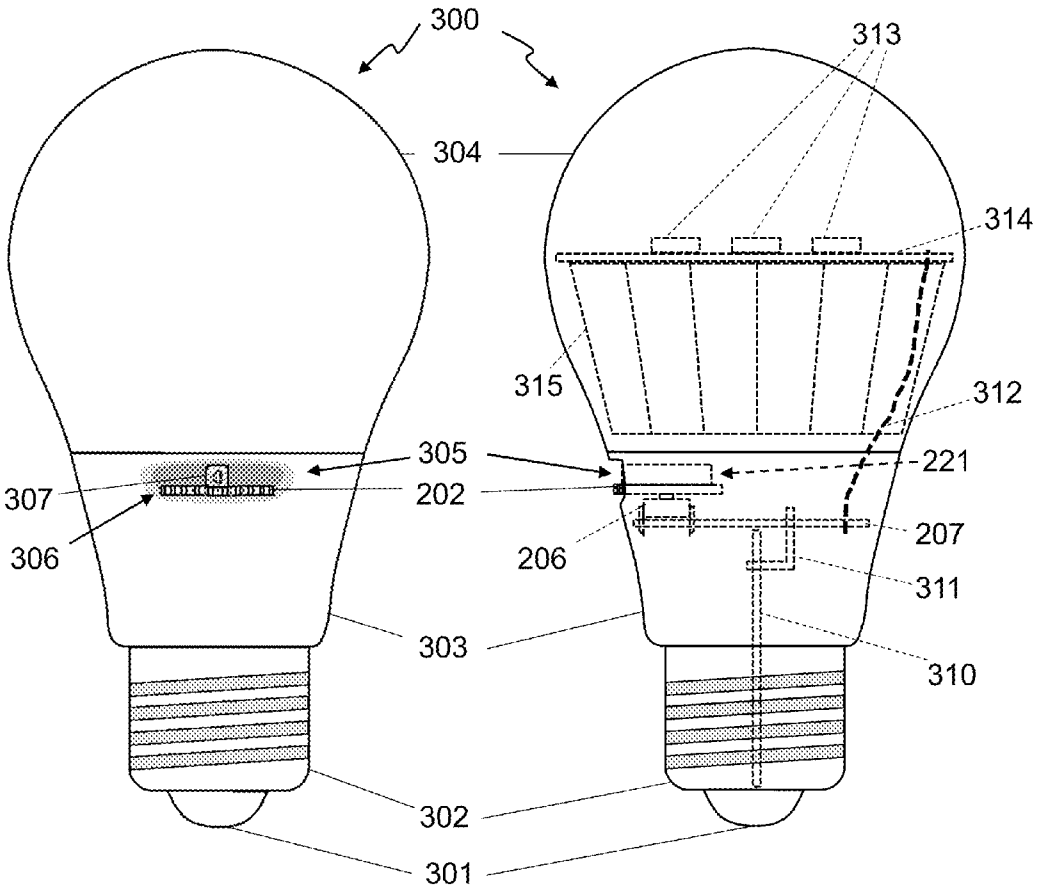
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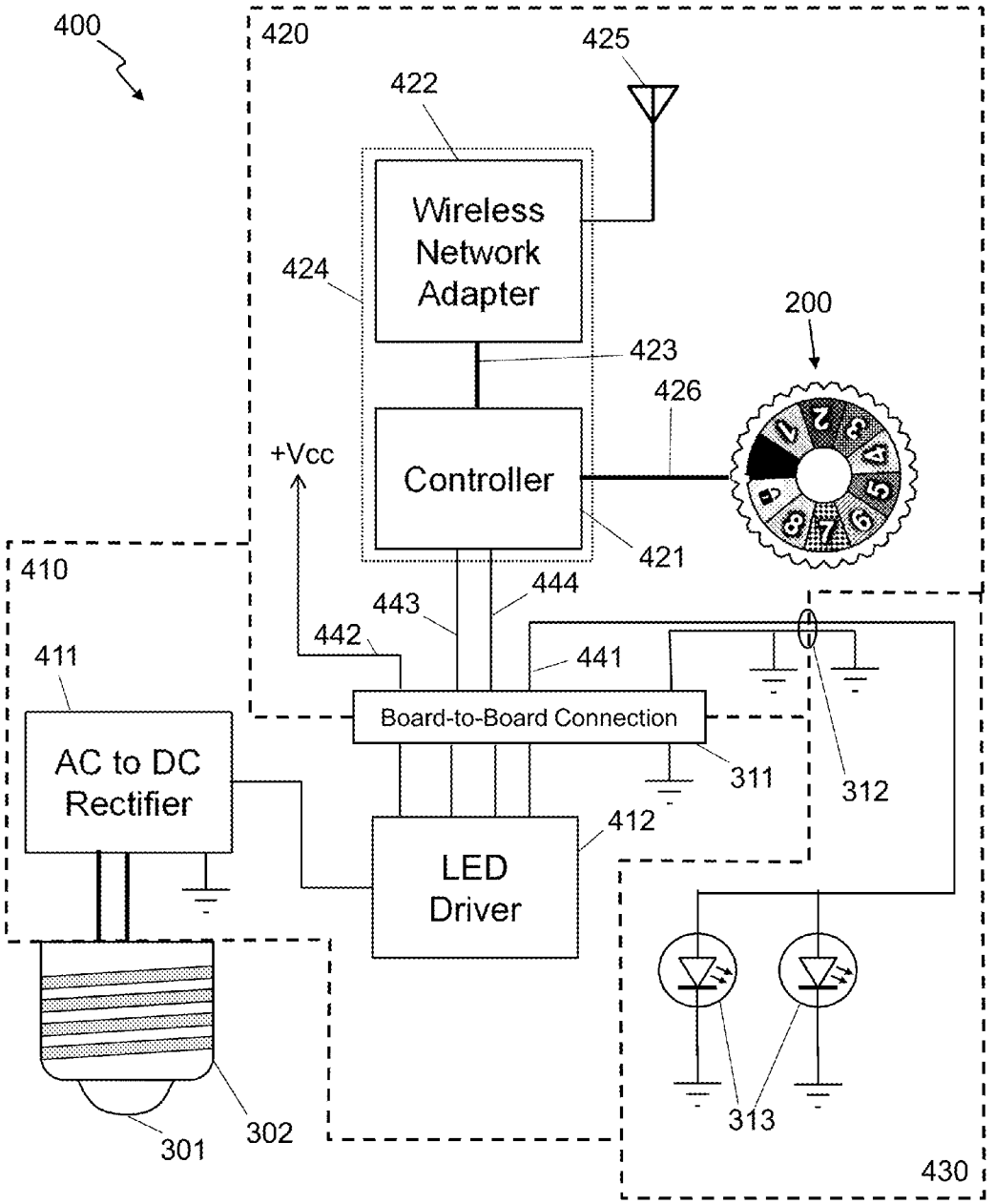
FIG. 3A FIG. 3B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420
425
422
Wireless Network Adapter
424
200
423
426
+Vcc
Controller
421
410
443
444
442
441
411
Board-to-Board Connection
AC to DC Rectifier
311
312
412
LED Driver
313
301
302
430

FIG. 4

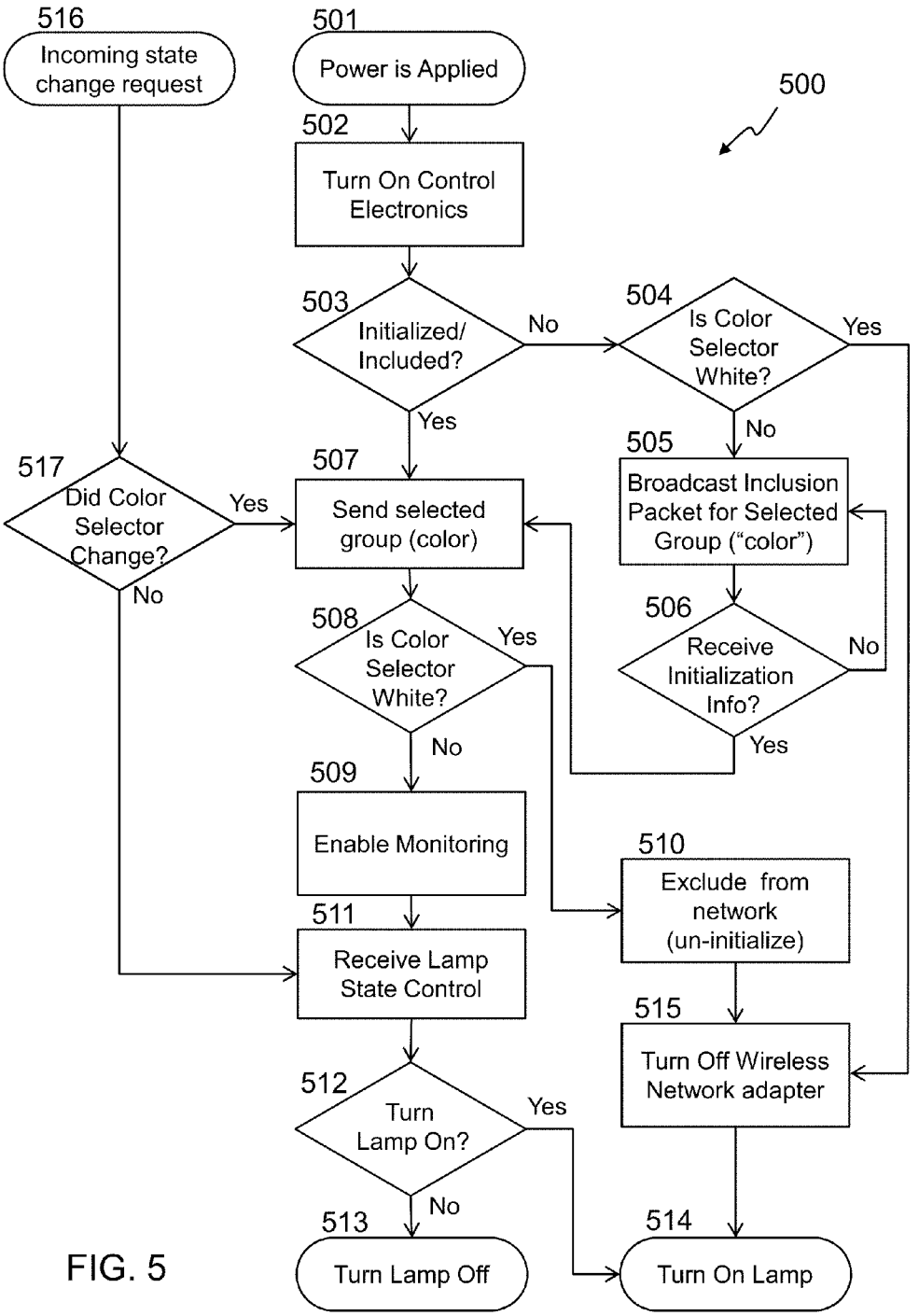
516
Incoming state change request
501
Power is Applied
500
502
Turn On Control Electronics
503
Initialized/ Included?
No
504
Is Color Selector White?
Yes
Yes
No
505
Broadcast Inclusion Packet for Selected Group ("color")
517
Did Color Selector Change?
Yes
507
Send selected group (color)
No
508
Is Color Selector White?
Yes
506
Receive Initialization Info?
No
Yes
No
509
Enable Monitoring
510
Exclude from network (un-initialize)
511
Receive Lamp State Control
515
Turn Off Wireless Network adapter
512
Turn Lamp On?
Yes
No
513
Turn Lamp Off
514
Turn On Lamp

FIG. 5

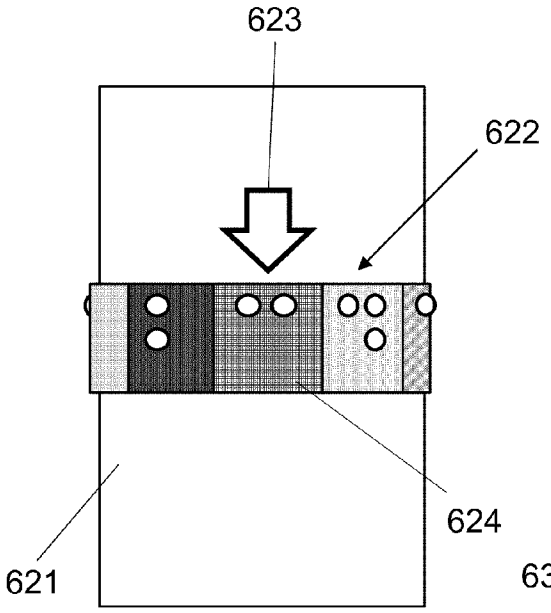

FIG. 6A

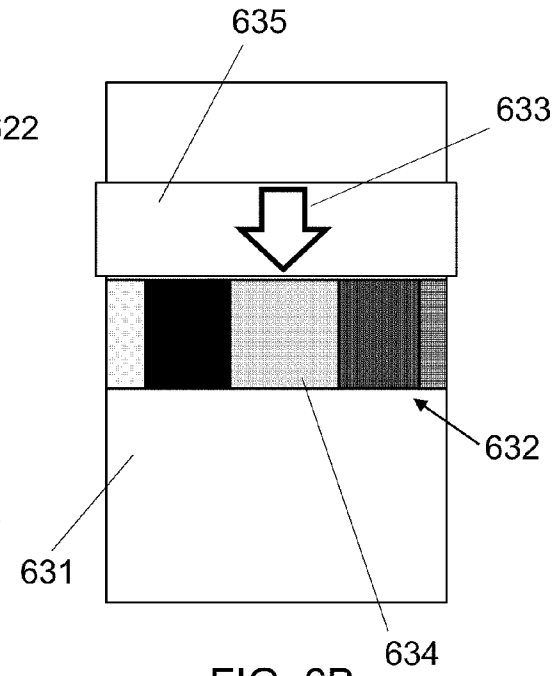

FIG. 6B

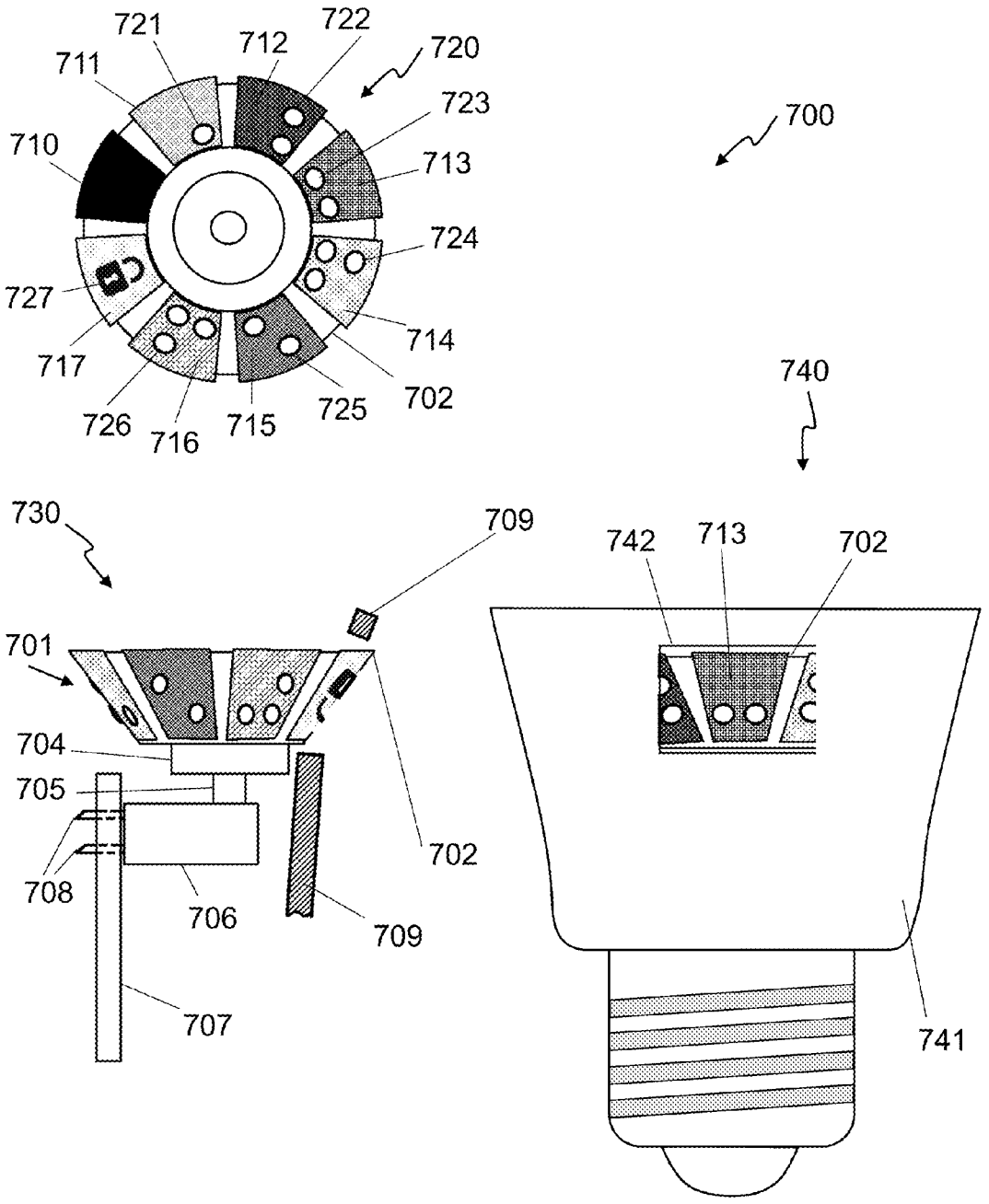
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FIG. 7

NETWORKED LIGHT BULB WITH COLOR WHEEL FOR CONFIGURATION

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional patent application Ser. No. 61/254,709 entitled "HYBRID LIGHT" and filed on Oct. 25, 2009, the entire contents of which is hereby incorporated by reference.

Background

1. Technical Field

The present subject matter relates to home automation networking. It further relates to initialization and setup of networked home automation devices.

2. Description of Related Art

Providing home automation functionality using networking means is well known in the art. Control of lighting and appliances can be accomplished using systems from many different companies such as X10, Insteon® and Echelon. These systems all require some kind of initialization and setup of the devices to communicate properly on the network. In some cases some of the initialization and setup is predefined in the device with no mechanism for the user to easily configure the device for their particular installation. But in many cases, a way for the user to configure the device at the time of installation is required. Light bulbs and light fixtures create a special challenge in that they are often installed in locations that can be hard to reach and people are not used to touching a light bulb, especially when it is on and could be quite hot.

US Pat. App. No. 2009/0237006 filed Mar. 18, 2008 by inventors Champion et al. shows a method and apparatus for identifying a group of devices where a controller receives a color identifying value over a communication channel from a management network and then combines the light emitted by the at least two LEDs into an identifying color that identifies a group of devices. In U.S. Pat. No. 4,918,690 issues on Apr. 17, 1990, the inventors Markkula et al. describe a network for sensing, communicating and controlling where each cell in the network is assigned a group identification number.

Inventor Dolin describes an apparatus and method for network node identification and network configuration in U.S. Pat. No. 5,519,878 issued on May 21, 1996. In Dolin's system, each device in the home automation network contains a unique ID that is obtained at the time of installation and then placed on a machine readable medium such as a bar code sticker. The bar code stickers for each device are then placed on paper floor plan to show the physical location of that device. The paper floor plan with the stickers is then read by an automatic configuration device to determine the physical location of each device for future use.

However, neither Champion et al., Markkula et al. nor Dolin address the ability of a user to set the network group or other parameters using a control mechanism on the device itself.

In US Pat. App. No. 2009/0267540, inventors Chemel at al. show an intelligent LED lighting system with mesh networking connectivity. Chemel et al. describe a power management module (PMM) with light module identification. Each light module may have identifying information programmed into it, and can communicate that information to the PMM, which can in turn store and communicate that information to a user or installer to aid in replacement or commissioning. The information may be stored in a nonvolatile memory onboard the light module, and communicated via a digital bus to the PMM. The information may be stored passively on the light module, such as via a series of jumpers or dip switches, and can be read by the PMM. The passive storage may include electrical contacts with encoded bit pattern stored in an optics holder. The passive storage may include passive RFID.

X10 markets a series of home automation control modules such as the PLM03 Lamp Module Receiver. Many X10 modules include two rotary control dials that the user can set at installation to allow each separate module to be independently controlled. One dial is for the "House Code" and can be set to a letter ranging from "A" to "P" while the other dial is for the "Unit Number" which can be set to a number ranging from 1 to 16.

It should be noted that neither the system described by Chemel et al. nor X10 devices address simplifying the way that the user can identify the location or other parameters of a device.

It therefore is important to provide a new method for the user to very easily configure a networked device for the home. The method should be very easy to remember and provide a simple means to configure at least the location or other basic parameter important to the networking of the device. It should also take the unique features of a light bulb or light fixture into account.

SUMMARY

Various embodiments of the present subject matter disclose methods and apparatus for configuring a networked lighting apparatus such as light bulb or light fixture. One embodiment of a method for configuring a networked lighting apparatus generates a selected color code corresponding to a color selected from a plurality of colors, the plurality of colors having at least one locking color and one or more non-locking colors and each color of the plurality of colors having a corresponding color code. It disables a network connection if the color selected is the at least one locking color. Only if the color selected is one of the one or more non-locking colors, it connects to the network, sends the selected color code over the network, and changes a state of the networked lighting apparatus in response to a message received over the network. In some embodiments the state of the networked lighting apparatus being changed is a brightness level of the networked lighting apparatus and in some embodiments the brightness level may be limited to On and Off. Some embodiments may set the brightness level of the networked lighting apparatus to at least 10% of maximum if the color selected is the at least one locking color and some embodiments may respond to a request for status information from the network only if the color selected is one of the one or more non-locking colors. One embodiment also receives a local control action and changes the state of the networked lighting apparatus in response to the local control action only if the color selected is one of the one or more non-locking colors.

One embodiment includes means for powering a light emitting device, means for controlling a brightness level of the light emitting device, means for connecting to a network, means for allowing a user to select a color from a plurality of colors, the plurality of colors having at least one locking color and one or more non-locking colors, and means for generating a selected color code corresponding to the color selected by the user, each color of the plurality of colors having a corresponding color code. The means for connecting to the network submits the selected color code over the network only if the color selected by the user is one of the one or more

non-locking colors and the means for controlling the brightness level of the light emitting device changes brightness level in response to a message from the network only if the color selected by the user is one of the one or more non-locking colors. In some embodiments, the brightness level is limited to On and Off. Some embodiments respond to a request for status information from the network only if the color selected by the user is one of the one or more non-locking colors. Some embodiments also include means for allowing the user enter a local brightness command but the means for controlling the brightness level of the light emitting device changes the brightness level in response to the local brightness command only if the color selected by the user is one of the one or more non-locking colors.

One embodiment of a networked light bulb comprises a light emitting apparatus, a controller, a network adapter communicatively coupled to the controller, and a color selection mechanism communicatively coupled to the controller, the color selection mechanism allowing a user to select a color from a plurality of colors, the plurality of colors having at least one locking color and one or more non-locking colors. The color selection mechanism communicates information corresponding to the color selected by the user to the controller and if the color selected by the user is the at least one locking color, the controller disables the network adapter. If the color selected by the user is one of the one or more non-locking colors, the controller converts the information communicated by the color selection mechanism to a color code corresponding to the color selected by the user, the controller communicates the color code to the network adapter, the network adapter sends the color code out over the network, the network adapter receives a message from the network to change a state of the networked light bulb and communicates it to the controller, and the controller changes the state of the networked light bulb in response to the message to change the state of the network light bulb communicated by the network adapter. In some embodiments, the network adapter connects to a wireless network such as Wi-Fi, Z-wave or Zigbee and in some instances the controller and the network adapter may be integrated on a single integrated circuit. In some embodiments the state of the networked light bulb being changed is a brightness level of the light emitting apparatus and it may be limited to On and Off. In some embodiments, the network adapter receives a status request message from the network and communicates it to the controller only if the color selected by the user is one of the one or more non-locking colors and the controller responds to the status request message communicated by the network adapter by communicating a response message to the network adapter to send out over the network.

In at least one embodiment, the color selection mechanism comprises a rotary switch with a rotatable shaft and an output communicatively coupled to the controller and a color wheel having a center, an edge and a colored area, the center of the color wheel coupled to the shaft of the rotary switch and the colored area divided into sections, each section imprinted with a section color selected from the plurality of colors. As the color wheel is rotated by user manipulation of the edge, the colored area of the color wheel and the rotatable shaft of the rotary switch also rotate and the output of the rotary switch communicates current rotational position information corresponding to the color selected by the user to the controller. In at least one embodiments, the color selection mechanism also has a selection mark in close physical proximity to the section of the colored area of the color wheel imprinted with the section color corresponding to the color selected by the user at the current rotational position. And in some embodiments, the networked light bulb further has an outer housing with an aperture. The color wheel is mounted in the networked light bulb so that a portion of the edge of the color wheel protrudes from the outer housing of the networked light bulb, whereby the user is able to manipulate the edge to rotate the color wheel about its center. A portion of the colored area is visible through the aperture in the outer housing of the networked light bulb with a majority of the portion of the colored area visible through the aperture in the outer housing of the networked light bulb is the section of the colored area imprinted with the section color corresponding to the color code selected by the user at the current rotational position. And in some embodiments the color wheel may also include visible or tactilely recognizable symbols.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute part of the specification, illustrate various embodiments of the invention. Together with the general description, the drawings serve to explain the principles of the invention. In the drawings:

FIG. **1** shows a table of color definitions used in this disclosure;

FIG. **2** shows an embodiment of a color wheel;

FIG. **3** shows a networked light bulb with a color wheel for configuration;

FIG. **4** shows a block diagram of the electronics utilized in one embodiment of the networked light bulb;

FIG. **5** is a flowchart describing how the color selection means is used in the configuration of a networked light bulb;

FIG. **6**A and **6**B show additional embodiments of color selection mechanism; and

FIG. **7** shows an alternative embodiment of a color wheel.

DETAILED DESCRIPTION

In the following detailed description, numerous specific details are set forth by way of examples in order to provide a thorough understanding of the relevant teachings. However, it should be apparent to those skilled in the art that the present teachings may be practiced without such details. In other instances, well known methods, procedures and components have been described at a relatively high-level, without detail, in order to avoid unnecessarily obscuring aspects of the present concepts. A number of descriptive terms and phrases are used in describing the various embodiments of this disclosure. These descriptive terms and phrases are used to convey a generally agreed upon meaning to those skilled in the art unless a different definition is given in this specification. Some descriptive terms and phrases are presented in the following paragraphs for clarity.

The term "LED" refers to a diode that emits light, whether visible, ultraviolet, or infrared, and whether coherent or incoherent. The term as used herein includes incoherent polymer-encased semiconductor devices marketed as "LEDs", whether of the conventional or super-radiant variety. The term as used herein also includes semiconductor laser diodes and diodes that are not polymer-encased. It also includes LEDs that include a phosphor or nanocrystals to change their spectral output.

The term "network" refers to a bidirectional communication medium and protocol to allow a plurality of devices to communicate with each other.

The term "networked device" refers to any device that can communicate over a network.

The terms "networked light fixture", "networked lighting apparatus" and "networked light bulb" all refer to a networked device capable of emitting light. While there are subtle differences in the generally agreed upon embodiments for these terms, they may be used interchangeably in this disclosure unless additional detail is provided to indicate that a specific embodiment is being discussed.

Reference now is made in detail to the examples illustrated in the accompanying drawings and discussed below.

FIG. **1** is a table **100** indicating some embodiments of the colors that could be used with the subject of the present disclosure. The first column **101** contains reference numbers 0-9 to be used for referring to each color. Some embodiments may use fewer than 10 colors while others may use more than 10 colors. The second column **102** contains symbols that may optionally be imprinted on top of the color to help people who may have difficulty distinguishing between different colors. In this embodiment, the first color has no symbol, the next 8 colors use an Arabic numeral as the symbol, and the final symbol is a padlock. Other visible symbols may be used in other embodiments. Tactilely recognizable symbols such as Braille may be used in other embodiments. The third column **103** contains the color names for the colors of this embodiment. Other colors could be used in other embodiments. The next four columns **104**, entitled "Print Colors", give one possible set of colors to be mixed for 4-color printing processes. The four columns **104** represent the percentage of the maximum amount of ink for the cyan (C%), magenta (M%), yellow (Y%), and black (K%) and can range from 0% to 100%. Other mixes might be used for some embodiments depending on the specific inks, print stock and exact desired color. The next three columns **105**, entitled "Computer Colors", give a possible representation for the indicated colors for use on a computer screen. The three columns **105** represent a color value for each of red (R), green (G) and blue (B) and range from 0 to 255 to allow the value for each component color to be stored in a single 8 bit storage location as is common in computer systems. The final (right-most) column **106**, entitled "Fill", gives a cross-hatch pattern that is used in the following black and white figures to indicate the color that would fill a particular area.

FIG. **2** shows one particular embodiment of a color selection mechanism **200** to allow a user to select a color. Top view **220** shows a color wheel **221** from the top and side view **230** shows the color wheel **221** from the side with some associated structure that has been omitted from the top view **220** for clarity. The color wheel mechanism **200** has a color wheel with a raised disc **201**, an edge **202** extending out beyond the raised disc, and a hub **204**. In some embodiments, the hub may not extend below the edge plane. The edge **202** may be knurled or textured to give better grip as it is rotated by the user. A colored area **203** is included on the color wheel. In this embodiment, the colored area **203** is implemented as a label that is wrapped around the raised disc **201** and attached with adhesive. The colored area **203** is divided into sections **210**-**219**, each section imprinted with a different color as defined in FIG. **1**. In this embodiment, section **210** is imprinted with color 0 and no identifying symbol. In this embodiment, color 0 is black. Section **211** is imprinted with color 1 and the symbol "1". Section **212** is imprinted with color 2 and the symbol "2". Section **213** is imprinted with color 3 and the symbol "3". Section **214** is imprinted with color 4 and the symbol "4". Section **215** is imprinted with color 5 and the symbol "5". Section **216** is imprinted with color 6 and the symbol "6". Section **217** is imprinted with color 7 and the symbol "7". Section **218** is imprinted with color 8 and the symbol "8". Section **219** is imprinted with color 9 and the symbol of a padlock to symbolize that this is the locking color. In this embodiment color 9 is white. The colors imprinted on the colored area **203** represent nine non-locking colors 0-8 and one locking color 9 which is white. Other embodiments may use more or less than ten colors. The color wheel hub **204** is attached to the shaft **205** of a rotary dip switch **206** that may be mounted on a printed circuit board **207**. As the color wheel **221** is turned, it turns the shaft **205** of the rotary dip switch **206** which generates information depending on the rotational angle of the shaft **205**. The information is then available on the pins **208** (not all pins are shown) of the rotary dip switch **206**. The pins **208** may be connected to pull-up resistors and a controller located on the same printed circuit board (or elsewhere in the networked light bulb). In one embodiment the rotary dip switch is a BCD encoder that generates 4 bits of output that can either be connected to ground or left as an open circuit so that as each output is connected to a pull-up resistor, the output represents a binary number between 0000 and 1010. Other methods of encoding the angular position of the color wheel **221** could also be used such as independent switches for each position, an optical shaft encoder, a magnetic detector, two-axis hall-effect sensors or other well-known methods of detecting the angular position of a disk or shaft.

FIG. **3**A shows a front view (with inner structure not shown) and FIG. **3**B shows a side view (with selected inner structure shown in broken lines) of the color selection mechanism **200** implemented in a networked light bulb **300**. In this embodiment a networked light bulb **300** is shown but other embodiments of the present subject matter could be a permanently installed light fixture with a socket for a standard light bulb, or a light fixture with embedded LEDs or any other sort of light emitting apparatus. The light bulb **300** is AC powered but other embodiments could be battery powered or solar powered. The networked light bulb **300** of this embodiment has a base with a power contact **301** and a neutral contact **302**, a middle housing **303** and an outer bulb **304**. Each section **301**, **302**, **303**, **304** can be made of a single piece of material or be assembled from multiple component pieces. The outer bulb **304** is at least partially transparent and may have ventilation openings in some embodiments, but the other sections **301**, **302**, **303** can be any color or transparency and be made from any suitable material. The middle housing **303** has an indentation **305** with a slot **306** and an aperture **307**. The color wheel **221** is attached to the shaft of rotary switch **206** which is mounted on a printed circuit board **207**. The printed circuit board **207** with the color wheel **221** is mounted horizontally so that the edge **202** of the color wheel protrudes through the slot **306** of the middle housing **303**. This allows the user to apply a rotational force to the color wheel **221**. As the color wheel **221** rotates, different sections of the colored area **203** of the color wheel **221** are visible through an aperture **307**. In FIG. **3**, the current position of the color wheel **221** is such the color section with color 4 is visible through the aperture **307**, indicating that the user has selected color 4 at this time. The color selection mechanism **200** may be designed to provide a detent at each section of the colored area **203** to make it clear what color is currently selected.

In this embodiment, a second printed circuit board **310** is mounted vertically in the base of the networked light bulb **300**. A board-to-board connection **311** is provided to connect selected electrical signals between the two printed circuit boards **207**, **310**. A third printed circuit board **314** has a plurality of LEDs **313** mounted on it and is backed by a heat sink **315** to cool the plurality of LEDs **313**. In some embodiments the third printed circuit board **314** with a plurality of LEDs **313** may be replaced by a single multi-die LED pack-

age or a single high output LED. In some embodiments the heat sink **315** may not be needed or could be a completely different configuration than what is shown. A cable **312** connects the printed circuit board **207** with the third printed circuit board **314**. The cable **312** carries the power for the plurality of LEDs **313**. In some embodiments it may be connect the second printed circuit board **310** directly to the third printed circuit board **314** instead of passing the signals through the printed circuit board **207**.

FIG. **4** shows a block diagram of the control electronics **400** used in the networked light bulb **300**. The block diagram is divided into three sections **410**, **420**, **430** corresponding to the three printed circuit boards of FIG. **3**. Other embodiments may partition the system differently and have more or fewer printed circuit boards or circuit elements. The three sections are the LED Driver section **410**, corresponding to the second printed circuit board **310**, the networked controller section **420**, corresponding to the printed circuit board **207**, and the LED section **430**, corresponding to the third printed circuit board **314**, The base with contacts **301**, **302** provides AC power to the AC to DC rectifier **411** to power the LED driver **412**. The LED driver may be an integrated circuit such as the NXP SSL2101 or similar parts from Texas Instruments or others. Several signals are shared in common between the LED driver section **410** and the networked controller section **420** through a board-to-board connection **311**. The board-to-board connection **311** may be a pin and socket connector system, an edge finger connector system, soldered right angle pins, a cable, or any other method of connecting two boards. The shared signals comprise a ground connection, the LED power signal **441**, a regulated power voltage **442**, a control signal **443** and a serial communication signal **444**. In some embodiments, the regulated power voltage **442** may be sufficient to power all the electronics in the networked controller section **420**. In other embodiments, where more power is needed, a DC to DC converter may be included in the networked controller section **420** running off the LED power signal **441**. The ground signal and the LED power signal **441** are then sent from the networked controller section **420** to the LED section **430** over cable **312**. The LED section **430** may have a plurality of LEDs **313** powered by the LED power signal **441**.

The networked controller section **420** has a wireless network adapter **422** that receives radio frequency signals through antenna **425** and is connected to controller **421** by a digital bus **423**. In some embodiments, the wireless network adapter **422** may connect to a Z-wave, Zigbee (IEEE 802.15.4) or Wi-Fi (IEEE 802.11) wireless network. Other embodiments may use a wired or power line network adapter instead of a wireless network adapter. In some embodiments, the controller **421** is implemented as a microcontroller and in some embodiments, the controller **421**, wireless network adapter **422**, and digital bus **423** may be integrated onto a single chip **424** such as the Zensys ZM3102. A color selection mechanism **200** is also connected to the controller **421** providing rotational position information through an electrical connection **426**. In other embodiments color selection mechanism may be provided using other means such as a graphical user interface on a display or a keypad or buttons or any other device or combination of devices that allows the user to select a color and provide information on the color chosen to the controller **421**.

In some embodiments, the controller **421** controls the brightness of the plurality of LEDs **313** by driving the control signal **443** back to the LED driver **412**. In one embodiment the controller **421** may simply drive the control signal **443** low to turn the plurality of LEDs **313** on and drive the control signal **443** high to turn the plurality of LEDs **313** off. In other embodiments, the controller **421** may drive the control signal **443** with a pulse-width modulated signal to control the brightness of the plurality of LEDS **313**. In some embodiments, the LED driver section **410** is designed to accept power that has been controlled by a standard thyristor-based light dimmer which varies the phase where the AC power is active. This can interact with the dimming control taking place over the network. To determine the current dimming level of the LEDs **313**, the networked controller section **420** may, in some embodiments, include circuitry to monitor the LED power signal **441** to determine the amount of dimming taking place. In other embodiments, the controller **421** may communicate with the LED driver **412** over the serial communications signal **444** to query and perhaps override the current dimming level. The serial communication signal **444** may also be used to communicate actual power used, color temperature control, device temperature information or any other status or control information that might need to be communicated between the controller **421** and the LED driver **412** in a particular embodiment. The serial communication signal **444** may be implemented with a unidirectional or a bidirectional communication protocol such as RS-232, I2C, USB, SPI or any other standard or proprietary protocol.

FIG. **5** shows a flow chart **500** for the operation of the networked light bulb **300** of the current subject matter. The exact order of operations and details shown in this flow chart **500** may differ between embodiments but one skilled in the art can see how the concepts presented herein would still apply. After power is applied **501**, the networked light bulb **300** turns the control electronics **400** on **512**. The controller **421** then checks **503** to see if the light bulb has been previously initialized and included into the network. If the device has not yet been initialized and included into the network, it checks **504** to see if the currently selected color is white (the locking color). If the currently selected color is white, the controller **421** turns off **515** the wireless network adapter **422** and then turns on **514** the LEDs **313** by driving the control signal **443** low.

If the color selected is not white, the controller **421** broadcasts **505** an inclusion packet over the network to let a network controller know that there is a new device on the network that needs to be initialized and configured. The controller **421** then waits for some period of time to receive **506** initialization information from the network controller. If no initialization information is received, the controller rebroadcasts **505** an inclusion packet and waits again, repeating this process until initialization information is received **506**. Once initialization information has been received, the controller **421** gets the color information the color selection mechanism **200**, converts it to the corresponding color code, and sends **507** the color code out to the network controller. The network controller uses the color code to help further configure the device and create a more user-friendly user interface for the entire network. One way the network controller may use the color code is to allow the user to assign a particular color to a room and set all the networked devices located in that room to the same color. An alternative use is to differentiate all similar devices using a different color so that the user can easily tell which device is which, as they interact with the network controller. In yet another use, the color can be used to group devices together that interact, such as all the audio-visual devices. The way that the color information is used by the network controller or other network devices is dependent on the implementation of the entire home automation system and may be invisible to the networked light bulb.

After the color code has been transmitted **507**, the controller **421** then determines **508** if the color selected is the locking color, white, in case the color selected has changed. If the locking color white has been selected, the controller **421** excludes **510** the networked light bulb **300** from the network, gracefully disconnecting from any services and in some embodiments, informing the network controller that it is dropping off the network. It also may remove network initialization information. It then turns off **515** the wireless network adapter, in some embodiments removing power from that device and in others just disabling its function. In some embodiments, the controller may also ignore all local control requests such as when the user presses a local power button or changes a local dimming control on the networked light bulb **300** if the locking color has been selected.

If the color selected on the color selection mechanism **200** is not white, in some embodiments the controller **421** may enable monitoring **509** of the status of the light bulb. A networked light bulb **300** may allow the network controller or other network devices to query its current brightness state, current power usage, current physical temperature of various components, the color temperature of the output of the plurality of LEDs **313**, diagnostic information or other information available to the networked light bulb that other devices on the network might find useful. The controller **421** then is enabled **511** to receive control messages over the network. If the control message tells the controller **421** to turn the device On **512**, the controller **421** drives the control signal low to turn on **514** the plurality of LEDs **313**. If the control packet tells the controller **421** to turn the device Off **512**, the controller **421** drives the control signal high to turn off **513** the plurality of LEDs **313**. Depending on the particular embodiment, many states other than the On/Off state may be controlled such as the brightness or the color temperature of the plurality of LEDs **313**. On occasion, new incoming state change requests may be received **516**. Those state change requests may come over the network or they may be received from a local user interface on the device such as changing the color selected. Whenever a new state change request is received **516**, the controller **421** checks to see if the color selected by the user on the color selection device **200** has changed **517**. In some embodiments, the act of changing the color may generate a state change request. If the color has changed **517**, the controller **421** sends **507** the new color out over the network to let the network controller know that the user has changed the color code on the device. The controller then proceeds through the same set of steps **508-515** as described in the initial power-up sequence. If the color has not changed **517**, there is no need to rebroadcast the color code or recheck to see if the color is white, so the controller simply receives the control message **511** and takes appropriate action **512-514**.

FIG. **6**A and **6**B show additional alternative embodiments of a color selection mechanism. FIG. **6**A shows a cylindrical portion **621** of the networked light bulb. Rotating color sleeve **622** can be rotated about the cylindrical element **621**. Selection indicator **623** points at the currently selected color on the rotating color sleeve **622**. The currently selected color in FIG. **6**A is color "3", the color of section **624**. FIG. **6**B also shows a cylindrical portion **631** of a networked light bulb. Rotating selector sleeve **635** with a selector indicator **633** can be rotated about the cylindrical element **631**. Fixed color ring **632** is affixed to the cylindrical element **631** adjacent to the rotating selector sleeve **635**. Selection indicator **633** points at the currently selected color on the fixed color sleeve **632**. In FIG. **6**B the currently selected color is color "1", the color of section **634**.

FIG. **7** shows another alternative embodiment of a color selection mechanism **700** to allow a user to select a color. Top view **720** shows the color wheel from the top and side view **730** shows the color wheel from the side with some associated structure that has been omitted from the top view **720** for clarity. The color wheel mechanism **700** has a color wheel with an angled side **701**, an edge **702** at the outermost part of the angled side **701**, and a hub **704**. The angle of the angled side **701** may range from 0 (parallel with the axis) to nearly 90 degrees (nearly flat). The edge **702** may be knurled or textured to give better grip as it is rotated by the user. A plurality of colored sections **710-717** are included on the angled side **701**. The colored sections **710-717** may be immediately adjacent to each other or may have some space with a neutral color between them as is shown in this embodiment. This embodiment has eight sections, each section a different color as defined in FIG. **1**. In this embodiment, section **710** is color 0, section **711** is color 1, section **712** is color 2, section **713** is color 3, section **714** is color 4, section **715** is color 5, section **716** is color 6, and section **717** is color 9. In this embodiment, visible and tactilely recognizable symbols are also included on some of the sections. Section **711** has the braille symbol for one **721**, section **712** has the braille symbol for two **722**, section **713** has the braille symbol for three **723**, section **714** has the braille symbol for four **724**, section **715** has the braille symbol for five **725**, section **716** has the braille symbol for six **726**, and section **717** has a raised padlock symbol **727**. Other embodiments may use other tactilely recognizable symbols. Yet other embodiments may not include tactilely recognizable symbols. In other embodiments the tactilely recognizable symbols may not be readily visible and other visible symbols may or may not be included. The colors on the angled edge **701** represent seven non-locking colors 0-6 and one locking color 9 which is white. The color wheel hub **704** is attached to the shaft **705** of a rotary dip switch **706** that may be mounted on a printed circuit board **707**. As the color wheel is turned, it turns the shaft **705** of the rotary dip switch **706** which generates information depending on the rotational angle of the shaft **705**. The information is then available on the pins **708** (not all pins are shown) of the rotary dip switch **706**. The pins **708** may be connected to pull-up resistors and a controller located on the same printed circuit board (or elsewhere in the networked device). In one embodiment the rotary dip switch is an octal encoder that generates 3 bits of output that can either be connected to ground or left as an open circuit so that as each output is connected to a pull-up resistor, the output represents a binary number between 000 and 111. Other methods of encoding the angular position of the color wheel could also be used such as an optical shaft encoder, a magnetic detector, two-axis hall-effect sensors or other well-known methods of detecting the angular position of a disk or shaft.

A cross section of a wall **709** of the networked light bulb shows the edge **702** protruding through the wall and a portion of the angled side **701** visible through an opening in the wall **709**. Exterior view **740** shows the outside of the networked light bulb with the wall **741** having an opening **742**. In the position shown, section **713** is filling most of opening **742**. The color selection mechanism **700** may be designed to provide a detent at each section **710-717** to make it easy for the user to center the desired section in the opening **742**.

Unless otherwise indicated, all numbers expressing quantities of elements, optical characteristic properties, and so forth used in the specification and claims are to be understood as being modified in all instances by the term "about." Accordingly, unless indicated to the contrary, the numerical parameters set forth in the preceding specification and

attached claims are approximations that can vary depending upon the desired properties sought to be obtained by those skilled in the art utilizing the teachings of the present invention. At the very least, and not as an attempt to limit the application of the doctrine of equivalents to the scope of the claims, each numerical parameter should at least be construed in light of the number of reported significant digits and by applying ordinary rounding techniques. Notwithstanding that the numerical ranges and parameters setting forth the broad scope of the invention are approximations, the numerical values set forth in the specific examples are reported as precisely as possible. Any numerical value, however, inherently contains certain errors necessarily resulting from the standard deviations found in their respective testing measurements.

The recitation of numerical ranges by endpoints includes all numbers subsumed within that range (e.g. 1 to 5 includes 1, 1.5, 2, 2.75, 3, 3.80, 4, and 5).

As used in this specification and the appended claims, the singular forms "a", "an", and "the" include plural referents unless the content clearly dictates otherwise. Thus, for example, reference to an element described as "an LED" may refer to a single LED, two LEDs or any other number of LEDs. As used in this specification and the appended claims, the term "or" is generally employed in its sense including "and/or" unless the content clearly dictates otherwise.

As used herein, the term "coupled" includes direct and indirect connections. Moreover, where first and second devices are coupled, intervening devices including active devices may be located there between.

Any element in a claim that does not explicitly state "means for" performing a specified function, or "step for" performing a specified function, is not to be interpreted as a "means" or "step" clause as specified in 35 U.S.C. §112, ¶6. In particular the use of "step of" in the claims is not intended to invoke the provision of 35 U.S.C. §112, ¶6.

The description of the various embodiments provided above is illustrative in nature and is not intended to limit the invention, its application, or uses. Thus, variations that do not depart from the gist of the invention are intended to be within the scope of the embodiments of the present invention. Such variations are not to be regarded as a departure from the intended scope of the present invention.

What is claimed is:

1. A method for configuring a networked lighting apparatus comprising:

generating a selected color code corresponding to a color selected from a plurality of colors, the plurality of colors having at least one locking color and one or more non-locking colors and each color of the plurality of colors having a corresponding color code;

disabling a network connection if the color selected is the at least one locking color; and

only if the color selected is one of the one or more non-locking colors,

(a) connecting to the network,

(b) sending the selected color code over the network, and

(c) changing a state of the networked lighting apparatus in response to a message received over the network.

2. The method for configuring the networked lighting apparatus of claim **1** further comprising responding to a request for status information from the network only if the color selected is one of the one or more non-locking colors.

3. The method for configuring the networked lighting apparatus of claim **1** further comprising:

receiving a local control action;

changing the state of the networked lighting apparatus in response to the local control action only if the color selected is one of the one or more non-locking colors.

4. The method for configuring the networked lighting apparatus of claim **1** wherein the state of the networked lighting apparatus being changed is a brightness level of the networked lighting apparatus.

5. The method of configuring the networked lighting apparatus of claim **4** wherein the brightness level is limited to On and Off.

6. The method of configuring the networked lighting apparatus of claim **4** further comprising:

setting the brightness level of the networked lighting apparatus to at least 10% of maximum if the color selected is the at least one locking color.

7. A networked light bulb comprising:

a light emitting apparatus;

a controller;

a network adapter communicatively coupled to the controller; and

a color selection mechanism communicatively coupled to the controller, the color selection mechanism allowing a user to select a color from a plurality of colors, the plurality of colors having at least one locking color and one or more non-locking colors; wherein

the color selection mechanism communicates information corresponding to the color selected by the user to the controller;

if the color selected by the user is the at least one locking color, the controller disables the network adapter; and

if the color selected by the user is one of the one or more non-locking colors,

(a) the controller converts the information communicated by the color selection mechanism to a color code corresponding to the color selected by the user,

(b) the controller communicates the color code to the network adapter,

(c) the network adapter sends the color code out over the network,

(d) the network adapter receives a message from the network to change a state of the networked light bulb and communicates it to the controller, and

(e) the controller changes the state of the networked light bulb in response to the message to change the state of the networked light bulb communicated by the network adapter.

8. The networked light bulb of claim **7** in which the network adapter connects to a wireless network selected from the group consisting of Wi-Fi, Z-wave and Zigbee.

9. The networked light bulb of claim **7** in which the controller and the network adapter are integrated on a single integrated circuit.

10. The networked light bulb of claim **7** in which

the network adapter receives a status request message from the network and communicates it to the controller only if the color selected by the user is one of the one or more non-locking colors; and

the controller responds to the status request message communicated by the network adapter by communicating a response message to the network adapter to send out over the network.

11. The networked light bulb of claim **7** in which the state of the networked light bulb being changed is a brightness level of the light emitting apparatus.

12. The method of configuring the networked lighting apparatus of claim 11 wherein the brightness level is limited to On and Off.

13. The networked light bulb of claim 7, the color selection mechanism comprising:

a rotary switch with a rotatable shaft and an output communicatively coupled to the controller; and

a color wheel having a center, an edge and a colored area, the center of the color wheel coupled to the shaft of the rotary switch and the colored area divided into sections, each section imprinted with a section color selected from the plurality of colors; such that

as the color wheel is rotated by user manipulation of the edge, the colored area of the color wheel and the rotatable shaft of the rotary switch also rotate; and

the output of the rotary switch communicates current rotational position information corresponding to the color selected by the user to the controller.

14. The networked light bulb of claim 13, the color selection mechanism further comprising:

a selection mark in close physical proximity to the section of the colored area of the color wheel imprinted with the section color corresponding to the color selected by the user at the current rotational position.

15. The networked light bulb of claim 13 further comprising an outer housing with an aperture; wherein

the color wheel is mounted in the networked light bulb so that,

a portion of the edge of the color wheel protrudes from the outer housing of the networked light bulb, whereby the user is able to manipulate the edge to rotate the color wheel about its center;

a portion of the colored area is visible through the aperture in the outer housing of the networked light bulb; and

a majority of the portion of the colored area visible through the aperture in the outer housing of the networked light bulb is the section of the colored area imprinted with the section color corresponding to the color code selected by the user at the current rotational position.

16. The networked light bulb of claim 13 in which at least one section of the colored area is also imprinted with a visible symbol.

17. The networked light bulb of claim 13 in which at least one section of the colored area has a tactilely recognizable symbol.

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